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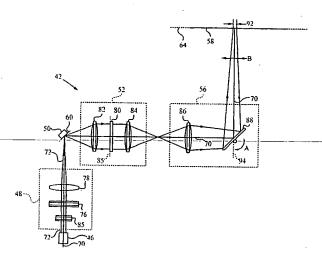
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(54) Title: ANGLED ILLUMINATION FOR A SINGLE ORDER GLV BASED PROJECTION SYSTEM



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(57) Abstract: A display apparatus projects a two dimensional image onto a display screen and includes illumination optics, a light modulator, separating optics and scanning optics. The light modulator is optically coupled to the illumination optics such that in operation the illumination optics illuminate the light modulator with an off-axis illumination and further such that the light modulator directs light onto an optic axis for a bright pixel, thereby forming on-axis light, and away from the optic axis for a dark pixel, thereby forming off-axis light. The separating optics are coupled to the light modulator and separate the off-axis and on-axis light where the on-axis light produces a real and virtual image that is displayed by the projection and scanning optics.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

 $\begin{array}{ccc} \text{Minimum documentation searched (classification system followed by classification symbols)} \\ IPC & 7 & G02B & H04N \end{array}$ 

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUM	ENTS CONSIDERED TO BE RELEVANT		·	
Calegory °	Citation of document, with indication, where appropriate, of the	Relevant to claim No.		
Х	US 5 629 801 A (BLOOM DAVID M 13 May 1997 (1997-05-13)	ET AL)	25-30	
Y	abstract		1-13, 15-23, 31-38	
Ą	claims 1-4 figures 2-4		14,24	
Υ	US 5 982 553 A (BLOOM DAVID M 9 November 1999 (1999-11-09) cited in the application	ET AL)	1-7, 15-21, 31-38	
A	abstract		8-14, 22-30	
	figures			
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χ Furt	ner documents are listed in the continuation of box C.	X Palent family members are liste	d in annex.	
•	tegories of cited documents:	"T" later document published after the in or priority date and not in conflict with	th the application but	
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filing d  *L* docume  which  citation	ate nt which may throw doubts on priority claim(s) or is cited to establish the publication date of another or other special reason (as specified)	<ul> <li>"X" document of particular relevance; the cannot be considered novel or cann involve an inventive step when the c</li> <li>"Y" document of particular relevance; the cannot be considered to involve an</li> </ul>	ot be considered to document is taken alone claimed invention inventive step when the	
other r P° docume	ant referring to an oral disclosure, use, exhibition or neans ant published prior to the international filing date but an the priority date claimed	document is combined with one or a ments, such combination being obvi in the art.  *&* document member of the same pater	ous to a person skilled	
	actual completion of the international search	Date of mailing of the international s	earch report	
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PCT/US 02/09604

C (Continu	ation) DOCUMENTS CONSIDERED TO BE RELEVANT	101703 02709004
Category °		Relevant to claim No.
 Ү А	EP 1 014 143 A (EASTMAN KODAK CO) 28 June 2000 (2000-06-28) abstract	8-13,22, 23 14,24
	page 6, line 28 - line 37 figure 8 	
A	EP 0 436 738 A (JAPAN BROADCASTING CORP) 17 July 1991 (1991-07-17) abstract figures 1,4-7	1-38
A	GLASER T ET AL: "BEAM SWITCHING WITH BINARY SINGLE-ORDER DIFFRACTIVE GRATINGS" OPTICS LETTERS, OPTICAL SOCIETY OF AMERICA, WASHINGTON, US, vol. 23, no. 24, 15 December 1998 (1998-12-15), pages 1933-1935, XP000802142 ISSN: 0146-9592 figure 1	1-38
A	US 6 091 521 A (POPOVICH MILAN M) 18 July 2000 (2000-07-18) abstract column 2, line 46 - line 64 column 5, line 15 - line 20 figures 2,3,5	1-38
Α	US 4 724 467 A (MARSHALL SIDNEY W ET AL) 9 February 1988 (1988-02-09) column 5, line 37 - line 43 figures 1,2	1-38
A	WO 97 26569 A (UNIV LELAND STANFORD JUNIOR) 24 July 1997 (1997-07-24) abstract figures 7,21,22,27,28	1-38
A	US 5 825 443 A (OHOKA TADAO ET AL) 20 October 1998 (1998-10-20) figures 1,2,20,22	1-38
A	US 5 798 805 A (OOI YOSHIHARU ET AL) 25 August 1998 (1998-08-25) abstract figures 15,30	1-38
Α	US 6 025 859 A (IDE ATSUSHI ET AL) 15 February 2000 (2000-02-15) abstract figures 1A,1B,11A,22	1-38

### INT NATIONAL SEARCH REPORT

Information on patent family members

iten onal Application No PCT/US 02/09604

				PC	1/05 (	12/09604
Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 5629801	A	13-05-1997	AT AU CN DE DE EP JP JP NO WO	200712 T 5981096 A 1187248 A 69612554 D 69612554 T 0830628 A 2941952 B2 10510373 T 975694 A 9641224 A1	,B 1 2 1 2	15-05-2001 30-12-1996 08-07-1998 23-05-2001 23-08-2001 25-03-1998 30-08-1999 06-10-1998 06-02-1998 19-12-1996
US 5982553	Α	09-11-1999	AU CN DE DE DK EP JP	6569098 A 1251178 T 69803656 D1 69803656 T2 968453 T3 0968453 A1 2000513114 T 994515 A	1 2 3 1	12-10-1998 19-04-2000 14-03-2002 13-06-2002 25-03-2002 05-01-2000 03-10-2000 17-09-1999
EP 1014143	Α	28-06-2000	WO US DE EP JP	9841893 A1 2001015850 A1 69901420 D1 1014143 A1 2000180737 A	 1 1	24-09-1998 
EP 0436738	A	17-07-1991	DE DE EP JP WO KR US	69023217 D1 69023217 T2 0436738 A1 2980372 B2 9102429 A1 185729 B1 5260815 A	2 1 2 1	30-11-1995 18-07-1996 17-07-1991 22-11-1999 21-02-1991 01-05-1999 09-11-1993
US 6091521	Α	18-07-2000	AU WO	1706600 A 0023834 A1	 1	08-05-2000 27-04-2000
US 4724467	A	09-02-1988	DE GB JP JP JP	3413644 A1 2140648 A 1801631 C 5005672 B 59206819 A		11-10-1984 28-11-1984 12-11-1993 22-01-1993 22-11-1984
WO_9726569	A	24-07-1997	US AT CA DE DE EP JP WO US	6219015 B1 217094 T 2243347 A1 69712311 D1 69712311 T2 0875010 A2 2001518198 T 9726569 A2 5808797 A	1 1 2 2	17-04-2001 15-05-2002 24-07-1997 06-06-2002 19-12-2002 04-11-1998 09-10-2001 24-07-1997 15-09-1998
US 5825443	Α .	20-10-1998	JP	9230321 A		05-09-1997
US 5798805	Α	25-08-1998	JP	8201757 A		09-08-1996
US 6025859	A	15-02-2000	JP	9174933 A		08-07-1997

information on patent family members

PCT/US 02/09604

	atent document	<del></del>	Publication	Datast family		PC1/US UZ	
cite	ed in search report		date		Patent family member(s)		Publication date
US	6025859	Α		JP JP	329087 918325	7 B2 5 A	10-06-2002 15-07-1997
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